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Handling the endogeneity of income to health using a field experiment in Taiwan

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Abstract

This paper uses an exogenous increase in income for a specific sub-group in Taiwan to explore the extent to which higher income leads to higher levels of health and wellbeing. In 1995, the Taiwanese government implemented the Senior Farmer Welfare Benefit Interim Regulation (SFWBIR) which was a pure cash injection, approximately US$110 (£70) per month in 1996, to senior farmers. A Difference-in-differences (DiD) approach is used on survey data from the Taiwanese Health and Living Status of Elderly in 1989 and 1996 to evaluate the short term effect of the SFWBIR on self-assessed health, depression, and life satisfaction. Senior manufacturing workers are employed as a comparison group for the senior farmers in the natural experiment because their demographic backgrounds are similar. This paper provides evidence that the increase in income from the SFWBIR significantly improved the mental health of senior farmers by reducing the scale of depression (CES-D) by 1.718, however, it had no significant short term impact on self-assessed health or life satisfaction.

JEL Classifications: I10, I38

Keywords: social welfare benefit, life satisfaction, mental health, natural experiment, difference-in-differences

1 Introduction

This paper seeks to identify the effect of increases in income on health outcomes. Income is a crucial factor for health, whether viewed in physical or psychological terms. For example, from a physical perspective money can buy more nutritious food and better quality medical treatment whereas from a psychological perspective money offers security and obviates financial stress. The exiting literature has inconsistent conclusions in terms of exactly how income influences health. Wilkinson (1996) claims that 'income per se does not affect health' but it affects health through several pathways, for instance, income comparison, the sense of relative deprivation, and income inequality (Chiang, 1999; Deaton and Lubotsky, 2003; Subramanian and Kawachi, 2004; Jones and Wildman, 2008) while others (Ettner, 1996; Pritchett and Summers, 1997; Berry, 2007; Gardner and Oswald, 2007) argue that the direct impact of income on health is the major factor through which income impacts on health. In the current paper we only explore the impact of an increase in income for the health and happiness of a particular sub-group and do not explore the mechanism through which the impact occurs.

A number of studies have investigated the relationship between health and income based on the assumption of a single causal direction, from income to health (Blakely et al., 2001; Chiang, 1999; Deaton and Lubotsky, 2003; Gravelle et al, 2002). However, while a strong social gradient in health may exist, from this alone one cannot disentangle the extent to which lower incomes cause poor health or poor health causes lower incomes. To investigate the causal relationships between income (or wealth) and health both cross-sectional (Ettner, 1996; Thomas and Strauss, 1997; Case, 2001) and longitudinal data (Adams et al, 2003; Adda et al, 2003; Meer et al, 2003; Contoyannis et al, 2004; Frijters et al, 2005; Lindahl, 2005; Gardner and Oswald, 2007) have been used.

Using cross-sectional data, Ettner (1996) investigates the effect of income on self-assessed health and chronic health limitations using a two-stage least squares (2SLS) method which uses the respondent's wage rate and non-earnings income to instrument for family income, as these are less likely to impacted by health shocks. Thomas and Strauss (1997) also employ 2SLS using commodity price indices and non-labour income as instruments to investigate the impact of wages on health in urban Brazil.

With longitudinal data some have used the sequencing of changes in income and health to identify the causal impact. For example, Adam et al. (2003) use innovations in health conditions and wealth to implement tests for the direct causal links from socioeconomic status to health and from health conditions to wealth in the elderly American population. Adda et al. (2003) replicate

the approach of Adam et al. (2003) using two panel data sets, the Whitehall II study in the UK and the ULF study in Sweden. While Contoyannis et al. (2004) employs a dynamic panel ordered probit approach to investigate the determinants of self-assessed health, in particular the effect of income and educational attainment. Other longitudinal studies that use an instrumental variable approach include, Meer et al. (2003) who investigates the relationship between changes in wealth and health status with inheritance as an instrument for changes in wealth and Lindahl (2005) who uses lottery wins as an instrument for average income. While Frijters et al. (2005) and Gardner and Oswald (2007) measure the direct effect on health of exogenous variations in income caused by changes in the political regime and lottery wins, respectively.

The interest of this paper is to investigate to what extent a cash injection to senior farmers through the Senior Farmer Welfare Benefit Interim Regulation (SFWBIR) improved their health status and happiness. In 1995, the Taiwanese government implemented the SFWBIR as a compensation for the absence of a retirement pension in the Farmer Health Insurance (FHI). Before 1995 FHI was the only occupational insurance in Taiwan that did not contain a retirement pension. Senior farmers were unable to receive any pension to secure their retirement whereas other workers claimed their retirement pension from their particular occupational insurance scheme. In 1996, with the SFWBIR, those senior citizens who were 65 years of age and had been members of FHI for at least 6 months were eligible to claim a specific amount (NT$ 3,000 which approximated to US$ 110 or £70 per month) of benefit until death. Though the SFWBIR is a social welfare benefit, it can also be regarded as a retirement pension for senior farmers. The difference between the SFWBIR benefit and retirement pension in occupational schemes is that the amount of the former is fixed, whereas the latter depends on their contribution. The hypothesis in this paper is that the income from the SFWBIR improved the health status and happiness of the senior farmers.

This paper uses a difference-in-differences (DiD) approach to estimate the casual impact of income on health outcomes in Taiwan. The primary sample/treatment group is senior farmers with the comparison sample or control group being senior manufacturing workers who have similar demographical characteristics as farmers. In the DiD estimations, the health status and happiness of the senior groups (65 – 75 year olds) from these two occupational groups are compared before and after the policy change. In addition, DiDiD estimations are used to explore the robustness of the results. In particular, two more comparison groups, non-senior farmers (60 - 64 years old) and non-senior manufacturing workers (60 – 64 years old), are included to explore whether there were different trends in health and happiness across workers from different sectors.

This paper is organised as follows. Section 2 introduces the social insurance schemes and welfare benefits in Taiwan and how these have changed in 1990s. Section 3 explains the data used from the Taiwanese survey of Health and Living Status of the Elderly in 1989 and 1996. Section 4 explains the empirical strategies employed to estimate the impact of the SFWBIR on health and happiness outcomes. Section 5 presents the empirical results and Section 6 discusses the conclusions.

2 Social insurance schemes and benefits in Taiwan

Social insurance schemes are a crucial component of the social security system in Taiwan. Such schemes can not only secure the economic wellbeing of senior citizens but also lighten the burden on the younger generation in the family. Before 1990, the occupational social schemes implemented in Taiwan included the Labour Insurance (LI), the Government Employee Insurance (GEI), the Private School Employee Insurance (PSEI), the Farmer Health Insurance, and the Military Insurance (MI). These occupational social schemes were compulsory and specific to particular occupations and, apart from the FHI and MI, they comprised three main components - pension, coverage of health expenses, and payment for specified events such as birth, disability, and funerals. The FHI managed the coverage of health expenses and payment for specified events but did not include a pension and MI included the payment of a pension and payment for specified events but did not cover health expenses.

In 1995, the National Health Insurance (NHI) was implemented. NHI is a pure health insurance scheme which merged the coverage of health expense from the above social insurances and the other health insurances such as the health insurance designed for low income family, government employee's family, private school employee's family, and retired government employees and their family.[1]

In the same year, the government carried out the SFWBIR in order to care for senior farmers because they were a relatively disadvantaged group in Taiwan. It could also be regarded as the compensation for the absence of a pension in the FHI. The amount of the SFWBIR benefit in 1996 was NT$ 3,000 which approximated to US$110 or £70. In order to put this amount into perspective, the reported minimum required living expense per month in Taiwan province, Taipei

[1] A few papers have investigated the impact of the National Health Insurance (NHI) on the pre-cautionary saving and mortality using a similar approach to that used in the current paper (see Chou et al., 2003; Keng and Sheu, 2012).

city, and Kaohsiung city was considered to be NT$5400, NT$6640, and NT$5400, respectively.[2] Thus, the SFWBIR benefit approximated to half of the minimum required living expenses.

3 Survey of health and living status of the elderly

The data is taken from the Survey of Health and Living Status of the Elderly (SHLSE). This survey was designed to measure the changes in health and living status of the elderly in Taiwan. This survey is a panel including six waves conducted in 1989, 1993, 1996, 1999, 2003, and 2007. The survey conducted in 1989 (the first wave) comprised 4,049 observations and those individuals were all aged 60 years and older. Given the age group there are large levels of attrition over time. In order to replenish the sample in 1996, a new cohort of 50-66 year-olds was added and a further cohort of 50-56 year-olds was added in 2003[3]. Therefore, some individuals have multiple data points over different years while others only have one. We define the individuals who have existed since 1989 as cohort I. The individuals added in 1996 are defined as cohort II and the individuals replenished in 2003 are defined as the cohort III. Thus, the third wave data comprises individuals from cohort I and cohort II and the data in 2003 and 2007 comprises individuals of cohort I, cohort II, and cohort III.

The SHLSE comprises questions relating to demographical information, health information, occupation, residence, and economic/financial wellbeing. It contains not only the current but also significant historical information with respect to marital status, employment and retirement, and living arrangement/residence. Health information includes self-assessed general health status, a measure of depression (CES-D, Centre for Epidemiologic Studies Depression Scale), health care utilization, and health care behaviours including consumption of alcoholic beverages, smoking and aspects of diet. Questions relevant to life satisfaction are also included in the survey, however, these were absent in the 1993 wave. A section devoted to the financial wellbeing of the respondents comprises of the (main) sources of their income, their asset structure, and management of finances. However, accurate income information is scant. Incomes are available in 1989 and 1996 (the third wave), though the income categories for these two waves are not consistent.[4]

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[2] Source: Directorate-General of Budget, Accounting and Statistics, Executive Yuan National Statistics, Taiwan (1996).

[3] The sample size of the new cohort in 1996 was 2462 and the sample size of the new cohort in 2003 was 1599.

[4] In the first wave, the income is respondent's monthly income and the categories are NT$0-3,000, NT$3,000-4,999, NT$5,000-9,999, NT$10,000-14,999, NT$15,000-19,999, NT$20,000-49,999, and more

4 Methods

In a natural experiment a treatment or shock occurs to some particular individuals but not to others. In this paper the implementation of the SFWBIR is considered a treatment to senior farmers. The manufacturing workers are selected as a comparison group because manufacturing workers and farmers have comparable socioeconomic backgrounds, such as, education level and unskilled occupational classification. Using SFWBIR as an instrument for changes in income possesses two advantages. First, it is easy to use the criteria of SFWBIR to partition the sample to the treatment group or control group. Second, the SFWBIR covered approximate one fifth of all Taiwanese senior citizens[5] in 1995 and 1996.

The age of those in the sample ranges from 60 years old to 75 years old and the farmers and manufacturing workers are partitioned into two groups by age (under 65 and 65 year old and older), respectively. The senior farmer subgroup is the treatment group and the other three groups, senior manufacturing worker group, non-senior farmer group, and non-senior manufacturing worker group, are considered as possible control groups.

Given that the SFWBIR policy change occurred in 1995, the data in 1993 and the data in 1996 represent pre- and post- policy intervention, respectively. However, the data in 1993 are replaced by the data in 1989 in the estimation procedure due to two reasons: (1) the life satisfaction information was absent in 1993; (2) the sample under 65 years old in 1993 was too small to use these as comparison groups.

The impact of the SFWBIR on three outcome variables is estimated. These outcomes are: (1) individual self-assessed health status (SAH), (2) individual scale of depression (CES-D) and (3) individual scale of life satisfaction (LS). The first variable has five categorical responses: very good, good, fair, poor and very poor. We follow the strategy of Jones and Wildman (2008) to convert SAH to a dichotomous variable which allows the implementation of a probit model in our estimation procedures. The value of 1 is assigned to the responses of very good and good and otherwise 0. Owing to the binary response model, the observed variable, H_{it}, in Eq. (1) is dominated by a latent variable, H_{it}*, which can be regarded as the health stock of the individuals. The individuals would report their health status as being very good or good when their health

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than NT$49,999. However, in the third wave, the income is respondent and spouses' annual income and the categories are NT$0-100,000, NT$100,000-299,999, NT$300,000-599,999, NT$600,000-999,999, NT$1,000,000-1,999,999, NT$2,000,000-4,999,999, and more than NT$4,999,999.

[5] Source: Department of Statistics, Ministry of Interior.

stock is above 0; otherwise fair, poor and very poor. Thus, a binary variable indicating the sign of H_{it}^{*} is observed:

$$(1)\quad H_{it} = \begin{cases} 1 & if\ H_{it}^{*} > 0 \\ 0 & if\ H_{it}^{*} \le 0 \end{cases}$$

The second variable is the scale of CES-D which is a measurement of depression and is also an indicator of mental health. It ranges from 0 (no depression) to 30 (extreme depression). The third variable is the scale of life satisfaction (LS) which is regarded as an indicator of happiness (Layard et al., 2008) and its scale is between 0 and 10, where the higher the score the greater the life satisfaction. Ordinary least squares (OLS) estimation is used in both CES-D and LS analyses.

For the income variable, the initial income defined as the income in 1989 is controlled in the estimations. However, it is unavailable for cohort II. Thus, the initial income predicted by interval regression is employed as the income variable in the estimations. For cohort I in 1989, the predicted initial income is obtained by implementing the interval regression with the dependent variable of categorical income and independent variables such as sex, age, education, marital status (married, divorce, and widow), region (north, middle, and south), working status, number of children in the family, and income source (from children, from pension, and from invested gain). The predicted initial income for the cohort I in 1996 is identical to that obtained above. The income equation for cohort I in 1996 is used to predict the incomes for cohort II in 1996. The first stage is to acquire the coefficients by implementing the interval regression with the dependent variable of categorical income in 1989 of cohort I and aforementioned independent variables in 1996 of cohort I. The second stage is to obtain the predicted initial income of the cohort II by using coefficients acquired at the first stage multiple the cohort II's variables which are the same as the independent variables in the first stage.

4.1 Difference-in-differences (DiD)

In the DiD design, the senior manufacturing workers group is the control group used to compare with the treatment group, senior farmers. To estimate the effect of SFWBIR on individuals' outcomes, the DiD strategy is to compare the changes in outcomes over time for the treatment group with the performance over time from the control group after controlling for changes in other factors. In particular it is assumed that without the implementation of the

SFWBIR policy the senior farmers would have experienced an identical change in outcomes as the senior manufacturing workers.

The test of Eq. (2) > 0 implies that SFWBIR improves health status and life satisfaction.

$$(2)\quad \Delta^{SFWBIR}_{Senior\ group} = (H^{Afetr\ SFWBIR}_{Senior\,Farmer} - H^{Before\ SFWBIR}_{Senior\,Farmer}) - (H^{After\ SFWBIR}_{Senior\,Manuf.wor\,ker} - H^{Before\ SFWBIR}_{Senior\,Manuf.wor\,ker})$$

The first parenthesis of right hand side in Eq. (2) presents the changes in outcomes of senior farmers from before to after the SFWBIR intervention. The changes are assumed to be caused by SFWBIR intervention and other factors related to senior farmers. Thus, the first parenthesis can be expressed as *P* (policy impact) + Oth_{SF} (the impact of other factors related to senior farmers). Likewise, the second parenthesis is equal to Oth_{SM} (the impact of other factors related to senior manufacturing workers) only because the policy is assumed to have no effect on senior manufacturing workers. The key assumption in DiD is that the policy impact is the only difference between two groups which implies $Oth_{SF} = Oth_{SM}$, the impact of other factors on the changes of senior farmer's outcomes is identical to that on the changes in senior manufacturing worker's outcomes. Thus, $\Delta^{SFWBIR}_{Senior\ group} = (P + Oth_{SF}) - (Oth_{SM}) = P$.

The pooled sample observed in 1989 and 1996 is used to estimate the effect of SFWBIR. The equation is as Eq. (3).

$$(3)\quad H_{it} = \alpha_0 + \delta_1 Post1995_{it} + \delta_2 Farmer_{it} + \delta_3 Post1995_{it} * Farmer_{it} + \alpha_1 X_{it} + \nu_{it}$$

where *i* indexes individuals and *t* indexes year. *H* is the response of self-assessed health status, the score of depression or life satisfaction, *Post1995* is a dummy for the period after implementation of SFWBIR, *Farmer* is a dummy for farmers, *X* is a vector of observable individual characteristics, which controls for the impact of changes in these variables over time and thus reduces the bias caused by omitted variables, and ν is a random error term. The effect of SFWBIR in Eq. (3) can be expressed as: $\Delta^{SFWBIR}_{Senior\ group} = [(\delta_1 + \delta_2 + \delta_3) - \delta_2] - [\delta_1 - 0] = \delta_3$. The coefficient δ_3 measures the difference-in-differences defined in Eq. (2).

4.2 Difference-in-difference-in-differences (DiDiD)

We employ a DiDiD estimation as a robustness check. Two more groups, the non-senior farmer group and the non-senior manufacturing worker group, are included in the model. The framework of DiDiD is as Eq (4) to Eq(6).

$$(4)\quad \Delta^{SFWBIR}_{Senior\ group} = (H^{After\ SFWBIR}_{SF} - H^{Before\ SFWBIR}_{SF}) - (H^{After\ SFWBIR}_{SM} - H^{Before\ SFWBIR}_{SM})$$

$$(5)\quad \Delta^{SFWBIR}_{Non-senior\ group} = (H^{After\ SFWBIR}_{NSF} - H^{Before\ SFWBIR}_{NSF}) - (H^{After\ SFWBIR}_{NSM} - H^{Before\ SFWBIR}_{NSM})$$

$$(6)\quad \Delta^{SFWBIR} = \Delta^{SFWBIR}_{Senior\ group} - \Delta^{SFWBIR}_{Non-senior\ group}$$

where Δ^{SFWBIR} and H have been defined above. *SF* and *SM* indicate the senior farmers and senior manufacturing workers defined at age 65 and order, respectively. *NSF* and *NSM* indicate the non-senior farmers and non-senior manufacturing workers, respectively.

Through the DiDiD estimation we relax the assumption in the DiD that the impact of other factors on the changes in farmer's and manufacturing worker's outcomes is identical ($Oth_{SF} \neq Oth_{SM}$). Instead the assumption in the DiDiD estimation is that, $Oth_{SF} - Oth_{SM}$ for the seniors is equal to $Oth_{NSF} - Oth_{NSM}$ for the non-seniors which implies that that any occupational difference from before to after the policy implementation is the same across our two age groups. Thus, Δ^{SFWBIR} is equal to the policy impact.

The DiDiD estimator can be expressed within a regression framework with the pooled data observed in 1989 and 1996. The regression is as Eq. (7):

$$\begin{aligned}(7)\quad H_{it} = {} & \beta_0 + \gamma_1 Post1995_{it} + \gamma_2 SC_{it} + \gamma_3 Farmer_{it} + \gamma_4 Post1995_{it} * SC_{it} \\ & + \gamma_5 SC_{it} * Farmer_{it} + \gamma_6 Post1995_{it} * Farmer_{it} \\ & + \gamma_7 Post1995_{it} * SC_{it} * Farmer_{it} + \beta_1 X_{it} + \varepsilon_{it}\end{aligned}$$

where *SC* is a dummy for senior citizens (65 years or older) and ε is a random error term and other variables have been defined in Eq. (3). The effect of SFWBIR in Eq. (7) can be expressed as $\Delta SFWBIR = \{[(\gamma_1+\gamma_2+\gamma_3+\gamma_4+\gamma_5+\gamma_6+\gamma_7)-(\gamma_2+\gamma_3+\gamma_5)]-[(\gamma_1+\gamma_3+\gamma_6)-\gamma_3]\}-\{[(\gamma_1+\gamma_2+\gamma_4)-\gamma_2]-[\gamma_1-0]\} = \gamma_7$. The coefficient γ_7 measures DiDiD defined in Eq. (6).

5 Empirical Results

5.1 Sample descriptive statistics

Table 1 depicts the sample statistics. In Table 1, the treatment group is the sub-group of senior farmers (defined by age at 65 years old or above) and control group 1 is the sub-group of non-senior farmers (defined by age younger than 65 years old). In the manufacturing worker group, control group 2 means the sub-group of senior manufacturing workers and control group 3 means the sub-group of the non-senior manufacturing workers.

The mean of self-assessed health of the farmer sub-groups were lower than their manufacturing counterparts (senior farmers vs. senior manufacturing workers and non-senior farmers vs. non-senior manufacturing workers) in 1989 and 1996. For the depression scale, the farmer sub-groups in 1989 reported higher depression scores than their counterparts. In 1996, the non-senior farmers still reported higher depression score than the non-senior manufacturing workers but the senior farmers reported lower depression scores than the senior manufacturing workers. With respect to life satisfaction, the mean of life satisfaction of the farmer sub-groups was higher than their counterpart in both years.

With respect to education, on average, the farmer sub-groups were more likely to report themselves as illiterate than their manufacturing counterpart. The farmer group and manufacturing group have similar education distributions which are skewed to the right. More than 80% of farmers and manufacturing workers report their education level as illiterate or primary school level which is 6 years or less. The distribution of other demographical variables, for example, marital status and family scale, also look similar in each sub-groups.

Table 1. 1989 sample statistics

	Farmer Group		Manufacturing Worker Group	
	Senior group	Non-senior group	Senior group	Non-senior group
	Mean (Std. Dev)	Mean (Std. Dev)	Mean (Std. Dev)	Mean (Std. Dev)
Health Indicators				
SAH	0.347 (0.477)	0.394 (0.49)	0.36 (0.482)	0.472 (0.501)
CES-D	5.647 (4.198)	5.614 (4.169)	4.894 (4.082)	5.337 (4.26)
LS	6.291 (2.4)	6.538 (2.411)	6.064 (2.239)	5.994 (2.512)
Educational Dummy				
Illiterate	0.525 (0.5)	0.404 (0.492)	0.388 (0.489)	0.258 (0.439)
Primary S.	0.428 (0.495)	0.555 (0.498)	0.455 (0.499)	0.621 (0.487)
Junior H.S.	0.031 (0.173)	0.031 (0.173)	0.103 (0.305)	0.093 (0.292)
Senior H.S.	0.012 (0.111)	0.007 (0.083)	0.042 (0.202)	0.016 (0.128)
University	0.002 (0.045)	0.003 (0.059)	0.012 (0.11)	0.011 (0.105)
Marital Status Dummy				
Married	0.691 (0.462)	0.821 (0.383)	0.606 (0.49)	0.731 (0.445)
Divorce	0.019 (0.135)	0	0.067 (0.25)	0.071 (0.258)
Widow	0.28 (0.449)	0.171 (0.377)	0.267 (0.444)	0.132 (0.339)
Single	0.006 (0.078)	0.007 (0.083)	0.061 (0.239)	0.066 (0.249)
Age	69.54 (3.171)	62.16 (1.3)	68.91 (2.932)	61.98 (1.368)
Male	0.669 (0.471)	0.688 (0.464)	0.679 (0.468)	0.769 (0.422)
Family Scale Dummy				
1-4 people	0.387 (0.488)	0.445 (0.498)	0.467 (0.5)	0.478 (0.501)
5-10 people	0.535 (0.499)	0.476 (0.5)	0.491 (0.501)	0.456 (0.499)
Over 10 people	0.078 (0.269)	0.079 (0.27)	0.042 (0.202)	0.066 (0.249)
Regional Dummy				
North	0.113 (0.317)	0.89 (0.285)	0.388 (0.489)	0.407 (0.493)
Middle	0.414 (0.493)	0.455 (0.499)	0.321 (0.468)	0.264 (0.442)
South	0.364 (0.482)	0.37 (0.484)	0.248 (0.433)	0.258 (0.439)
East	0.109 (0.312)	0.086 (0.28)	0.042 (0.202)	0.071 (0.258)
Job Type Dummy				
Self-employed	0.309 (0.462)	0.479 (0.5)	0.03 (0.172)	0.055 (0.229)
Family Business	0.002 (0.045)	0.01 (0.101)	0	0.027 (0.164)
Employee	0.039 (0.194)	0.079 (0.271)	0.188 (0.392)	0.473 (0.501)
Retire	0.008 (0.09)	0.01 (0.101)	0.145 (0.354)	0.132 (0.339)
Others†	0.642 (0.48)	0.421 (0.495)	0.636 (0.483)	0.313 (0.465)
No. of children	5.549 (2.185)	5.19 (1.757)	4.558 (2.15)	4.167 (2.175)
Predicted 1989 Income (NT$1,000)	12.017 (12.189)	11.2 (10.462)	14.113 (13.974)	13.452 (11.838)
Sample size	486	292	165	182

† The individuals in this group are the ones who are not included in the other groups.

Table 1. (continue) 1996 sample statistics

	Farmer Group		Manufacturing Worker Group	
	Senior group	Non-senior group	Senior group	Non-senior group
	Mean (Std. Dev)	Mean (Std. Dev)	Mean (Std. Dev)	Mean (Std. Dev)
Health Indicators				
SAH	0.371 (0.484)	0.379 (0.489)	0.423 (0.499)	0.519 (0.505)
CES-D	6.756 (4.476)	7.518 (5.16)	7.481 (4.889)	6.288 (3.357)
LS	6.5 (2.488)	6.328 (2.465)	6.18 (2.561)	6.137 (2.474)
Educational Dummy				
Illiterate	0.384 (0.488)	0.317 (0.467)	0.327 (0.474)	0.208 (0.409)
Primary S.	0.551 (0.499)	0.641 (0.481)	0.49 (0.505)	0.66 (0.478)
Junior H.S.	0.051 (0.22)	0.021 (0.144)	0.164 (0.373)	0.113 (0.32)
Senior H.S.	0.005 (0.068)	0.021 (0.144)	0	0.019 (0.137)
University	0.009 (0.096)	0	0.018 (0.135)	0
Marital Status Dummy				
Married	0.81 (0.393)	0.831 (0.376)	0.709 (0.458)	0.868 (0.342)
Divorce	0.023 (0.151)	0	0.018 (0.135)	0.057 (0.233)
Widow	0.162 (0.369)	0.148 (0.356)	0.218 (0.419)	0.038 (0.192)
Single	0.005 (0.068)	0.021 (0.144)	0.055 (0.229)	0.038 (0.192)
Age	69.2 (2.819)	62 (1.326)	68.96 (2.236)	61.47 (1.324)
Male	0.75 (0.434)	0.577 (0.496)	0.655 (0.48)	0.792 (0.409)
Family Scale Dummy				
1-4 people	0.556 (0.498)	0.465 (0.501)	0.509 (0.505)	0.415 (0.497)
5-10 people	0.407 (0.492)	0.493 (0.502)	0.473 (0.504)	0.528 (0.504)
Over 10 people	0.037 (0.189)	0.042 (0.202)	0.018 (0.135)	0.057 (0.233)
Regional Dummy				
North	0.102 (0.303)	0.127 (0.334)	0.418 (0.498)	0.302 (0.463)
Middle	0.495 (0.501)	0.366 (0.483)	0.327 (0.474)	0.415 (0.497)
South	0.324 (0.469)	0.451 (0.499)	0.218 (0.417)	0.245 (0.434)
East	0.079 (0.27)	0.056 (0.231)	0.036 (0.189)	0.038 (0.192)
Job Type Dummy				
Self-employed	0.486 (0.501)	0.486 (0.502)	0.073 (0.262)	0.154 (0.364)
Family Business	0.023 (0.151)	0.007 (0.084)	0.018 (0.135)	0.019 (0.139)
Employee	0.056 (0.231)	0.028 (0.166)	0.581 (0.498)	0.788 (0.412)
Retire	0.019 (0.136)	0.021 (0.144)	0.036 (0.189)	0.019 (0.139)
Others†	0.416 (0.494)	0.458 (0.5)	0.291 (0.458)	0.019 (0.139)
No. of children	5.139 (1.974)	4.789 (1.692)	3.818 (2.118)	3.925 (1.697)
Predicted 1989 Income (NT$1,000)	13.114 (7.676)	24.478 (10.971)	16.558 (7.907)	26.12 (4.955)
Sample size	216	142	55	53

† The individuals in this group are the ones who are not included in the other groups.

When the senior sub-groups are compared, the proportion retired in senior farmer group is much lower than senior manufacturing group in the pre-SFWBIR wave. This may be due to no legally forced age of retirement for farmers. In the post-SFWBIR wave, this proportion reduces rapidly. A possible reason is the implementation of SFWBIR increased the farmer's probability of retirement.

The gap of predicted initial income for senior groups and non-senior groups in 1989 ranged approximately from 17% to 20%. The predicted initial income of senior farmers was lower than that of senior manufacturing workers by 17% and the predicted initial income of non-senior farmers was lower than that of non-senior manufacturing workers by 20%. However, in 1996, the gap of predicted initial income among senior sub-groups broadened to 26% but the gap of predicted initial income among non-senior sub-groups narrowed down to 6.7%. This implies that some initial income predictors, such as age, working status and major income source, in 1996 differ from those in 1989.

5.2 Difference-in-differences estimation

The column of SAH of the basic specification in Table 2 shows that SFWBIR has no statistically significant effects on treatment group. In the bottom rows, the other control variables identified in Eq. (2) are included. In the full specification model of SAH, the coefficient of SFWBIR on the treatment group is negative but it is not statistically significant at 5%. Education, but only the junior high school level, contributes the self-assessed health status significantly. People whose education level is at junior high school level have a higher probability of reporting good self-assessed health status compared with illiterate subjects, holding other characteristics constant. The dummies of marital status do not have statistically significant effects on self-assessed health status.

Age has a non-significantly positive effect on self-assessed health status, holding other characters constant. However, the gender dummy has a significantly positive effect on self-assessed health. The probability of males to report good self-assessed health is higher than that of females, holding other characteristics constant.

With respect to regional dummies, the north has positive and significant effects on self-assessed health compared with the east and it is significant at 5% level. Self-employed, employed and retired people have a significantly higher probability of reporting good self-assessed health than those who are defined as the category of others. The significant level is at 1% and 5% level, respectively.

The column of CES-D shows that SFWBIR has a negative effect on CES-D of treatment group in the basic specification model and it is only significant at 10% level.

In the full specification estimate, the effect of SFWBIR on treatment group maintains negative but it turns to significant at 5% level. SFWBIR decreases the depression scale of senior farmers by 1.718 points compared to senior manufacturing workers. With respect to other control variables, median families (5-10 people) and large families (over 10 people) report significantly (0.855 point and 1.477 points) lower depression compared with small families (1-4 people). Self-employed people report 0.724 lower score of depression compared with people who are classed group others.

The column of LS presents the results of estimating life satisfaction. In the basic specification model the effect of SFWBIR on the treatment group is positive but not significant at 5%. In the full specification it is negative and not statistically significant. The education dummies are positive apart from university dummy but only junior high school level is significant at 5% level.

With respect to marital status, the divorce has a negative effect on the life satisfaction but the significant level is at 10%. Large family size has a positive and significant effect on life satisfaction and the significant level is at 5%. On average, large family raises 0.692 life satisfaction score. Self-employed and retired people report significantly higher life satisfaction. The coefficients are 0.593 and 1.093, respectively and significant at 1% level.

Table 2. Difference-in-Difference Empirical Results

	SAH	**CES-D**	**LS**
	Coef. (Robust S. E.)	**Coef. (Robust S. E.)**	**Coef. (Robust S. E.)**
		Basic Specification	
Post 1995	0.137 (0.203)	2.625 (0.748)***	0.167 (0.403)
Farmer	-0.061 (0.119)	0.791 (0.381)**	0.277 (0.215)
Farmer*Post1995	**-0.073 (0.229)**	**-1.516 (0.833)***	**0.043 (0.456)**
		Full Specification	
Post1995	0.02 (0.227)	3.062 (0.766)***	0.043 (0.42)
Farmer	0.051 (0.15)	0.731 (0.445)	0.089 (0.243)
Farmer*Post1995	**-0.107 (0.249)**	**-1.718 (0.847)****	**-0.046 (0.466)**
Primary School	0.024 (0.107)	-0.321 (0.325)	0.317 (0.194)
Junior High School	0.411 (0.208)**	-0.6 (0.671)	0.698 (0.312)**
Senior High School	0.091 (0.391)	-0.199 (0.744)	0.601 (0.639)
University	1.002 (0.673)	-2.113 (1.237)*	-0.147 (0.561)
Marital Status: Married	-0.044 (0.465)	2.364 (1.608)	-0.179 (0.842)
Marital Status: Divorce	0.082 (0.54)	2.179 (1.741)	-1.841 (1.002)*
Marital Status: Widow	-0.023 (0.469)	3.098 (1.617)*	-0.906 (0.852)
Age	0.54 (0.75)	0.326 (2.212)	0.512 (1.285)
Squire of age	-0.004 (0.005)	-0.002 (0.016)	-0.004 (0.009)
Gender	0.305 (0.118)**	-0.27 (0.366)	-0.007 (0.211)
Family Scale			
5-10 people	0.011 (0.096)	-0.855 (0.311)***	0.067 (0.178)
Over 10 people	-0.115 (0.205)	-1.477 (0.519)***	0.692 (0.343)**
Region-North	0.481 (0.201)**	-0.326 (0.538)	-0.028 (0.377)
Region-Middle	0.226 (0.176)	-0.1 (0.457)	0.224 (0.325)
Region-South	0.285 (0.18)	0.531 (0.471)	0.268 (0.335)
Job Type			
Self-employed	0.554 (0.112)***	-0.724 (0.352)**	0.593 (0.2)***
Family Business	0.482 (0.506)	0.64 (1.811)	-0.269 (1.042)
Employed	0.433 (0.172)**	-0.762 (0.605)	0.123 (0.338)
Retired	0.594 (0.25)**	-0.529 (0.615)	1.093 (0.31)***
No. of children	0.026 (0.022)	-0.073 (0.068)	0.051 (0.042)
Predicted 1989 Income	0.004 (0.004)	-0.013 (0.013)	-0.001 (0.006)
Sample size	854	845	812†
R^2	0.07 (pseudo)	0.081	0.082

*** , **, and * present statistically significant at the 1%, 5%, and 10% level, respectively

† The sample size in the estimates of LS is smaller than that in the estimates of SAH and CES-D because more missing values exist in the questions of life satisfaction.

Table 3. Difference-in-Difference-in-Differences Empirical Results

	SAH	CES-D	LS
	Coef. (Robust S. E.)	**Coef. (Robust S. E.)**	**Coef. (Robust S. E.)**
		Basic Specification	
Post 1995	0.077 (0.198)	1.088 (0.563)*	0.162 (0.396)
SC (Senior Citizen)	-0.302 (0.141)**	-0.344 (0.459)	0.038 (0.269)
Farmer	-0.239 (0.122)*	0.414 (0.407)	0.562 (0.245)**
Farmer*SC	0.178 (0.17)	0.377 (0.558)	-0.285 (0.326)
Farmer*Post1995	-0.119 (0.238)	0.815 (0.755)	-0.372 (0.476)
Post1995*SC	0.06 (0.284)	1.536 (0.937)	0.005 (0.566)
Farmer*SC*Post1995	**0.045 (0.331)**	**-2.331 (1.125)****	**0.414 (0.66)**
		Full Specification	
Post1995	0.018 (0.213)	1.319 (0.564)**	0.085 (0.412)
SC (Senior Citizen)	-0.329 (0.206)	-1.208 (0.627)*	0.438 (0.365)
Farmer	-0.105 (0.15)	0.34 (0.495)	0.479 (0.29)*
Farmer*SC	0.125 (0.186)	0.618 (0.577)	-0.418 (0.332)
Farmer*Post1995	-0.038 (0.249)	0.719 (0.744)	-0.314 (0.484)
Post1995*SC	-0.044 (0.299)	1.547 (0.92)*	-0.07 (0.566)
Farmer*SC*Post1995	**-0.015 (0.345)**	**-2.182 (1.089)****	**0.304 (0.651)**
Primary School	0.052 (0.082)	-0.41 (0.258)	0.336 (0.153)**
Junior High School	0.565 (0.163)***	-0.782 (0.554)	0.781 (0.237)***
Senior High School	0.028 (0.289)	-0.514 (0.625)	0.755 (0.485)
University	0.614 (0.48)	-2.085 (1.049)**	0.165 (0.443)
Marital Status: Married	0.187 (0.312)	0.402 (1.415)	-0.055 (0.66)
Marital Status: Divorce	0.229 (0.347)	0.376 (1.523)	-1.223 (0.771)
Marital Status: Widow	0.234 (0.319)	1.136 (1.432)	-0.776 (0.673)
Age	0.399 (0.343)	0.643 (1.076)	0.05 (0.619)
Squire of age	-0.003 (0.002)	-0.004 (0.008)	-0.0004 (0.004)
Gender	0.292 (0.088)***	-0.3 (0.284)	0.092 (0.164)
Family Scale			
5-10 people	0.042 (0.073)	-0.824 (0.238)***	0.214 (0.135)
Over 10 people	0.13 (0.143)	-1.047 (0.387)***	0.746 (0.253)***
Region-North	0.608 (0.157)***	-0.008 (0.412)	0.031 (0.303)
Region-Middle	0.263 (0.143)*	0.022 (0.363)	0.178 (0.268)
Region-South	0.451 (0.144)***	0.497 (0.368)	0.39 (0.272)
Job Type			
Self-employed	0.594 (0.086)***	-1.108 (0.284)***	0.663 (0.154)***
Family Business	0.574 (0.327)*	0.471 (1.169)	0.501 (0.606)
Employed	0.469 (0.119)***	-0.413 (0.413)	0.304 (0.241)
Retired	0.317 (0.186)*	-0.311 (0.486)	0.868 (0.284)***
No. of children	0.009 (0.018)	-0.05 (0.056)	0.085 (0.035)**
Predicted 1989 Income	0.0001 (0.003)	-0.013 (0.01)	0.003 (0.005)
Sample size	1473	1457	1399†
R^2	0.075 (Pseudo)	0.081	0.085

*** , **, and * present statistically significant at the 1%, 5%, and 10% level, respectively

† The sample size in the estimates of LS is smaller than that in the estimates of SAH and CES-D because more missing values exist in the questions of life satisfaction.

5.3 Difference-in-difference-in-differences estimation

The basic specification model in column of SAH in Table 3 shows the effect of SFWBIR on self-assessed health of treatment group is positive but not significant at 10% level. In the full specification, it becomes negative and still statistically non-significant at 10% level. The significant variables are the dummies of junior high school, gender, regional dummies, and the job type dummies. These dummies are all significant at 1% level apart from the dummies of middle region, people who work in family business and retired. These dummy variables are only significant at 10% level. People with the education at junior high school have higher probability to report good health status than those who are illiterate, holding other variables constant. Males have higher probability to report good health status than females. People in the north and south areas have higher probability to report good health status compared with those in the east. Finally, the self-employed and employed people have higher probability to report good health status compared with those categorized in others, respectively.

The basic specification model in column of CES-D shows that SFWBIR reduces the depression of treatment group and it is significant at 5% level. In the full specification model, the effect of SFWBIR on CES-D of treatment group maintains negative and significant at 5% level. SFWBIR reduces the depression of treatment group by 2.182 points.

With respect to the control variables, only the dummies of university level, two family size, and self-employed job types are significant either at 1% or 5% level. People whose education is at university level report less depression than illiterate by 2.085 scores. People in the middle family (5-10 persons) and large family (over 10 persons) report less depression than those in small family size (1-4 persons) by 0.824 point and 1.047 points respectively, holding other variables constant. Self-employed people have less depression than those categorized in others by 1.108 points.

The basic specification model in column of LS shows the effect of SFWBIR on life satisfaction of treatment group is positive but not significant at 5% level. In the full specification model, it maintains positive and not significant at 5% level.

With respect to other variables, the significant dummies are primary school, junior high school, large family size, self-employed job type, retirement, and the number of children at 1% and 5% levels, respectively. People whose education is at primary school and junior high school levels report higher life satisfaction than those who are illiterate by 0.336 point and 0.781 point, respectively, holding other variables constant. People report higher life satisfaction in large

family size than in small family by 0.746 point. Self-employed and retired people have higher life satisfaction than those categorized in others by 0.663 point and 0.868 point, respectively. Finally, the number of children also increases individual's life satisfaction and its coefficient is 0.085.

6 Conclusion

This paper uses natural experimental approaches, difference-in-differences and its extension difference-in-difference-in-differences, to identify the effect of the Senior Farmer Welfare Benefit Interim Regulation on self-assessed health status, depression, and life satisfaction of the treatment group, the senior farmers. SFWBIR appeared to significantly reduce depression in senior farmers and this result was robust to different specifications. The effect of SFWBIR on self-assessed health status and life satisfaction appeared to be negative, however, this results was not statistically significant at 5% level and was not always robust to alternative specifications. In summary, the pure cash injection policy had no significant short-term effect on self-assessed health status and life satisfaction but had a significant short-term effect on relief of depression. It provides some evidence that income can improve mental health. It also shows there is a lack of evidence that in the short term income is a significant determinant of happiness.

The policy effect on depression is shorter than what is observed in the work of Gardner and Oswald (2007) where they observe the impact of a lottery win on mental health after two years of the lottery win. Two reasons might explain this difference. First, the instruments of income innovation are different. Policy intervention is permanent and anticipated whereas lottery wins are a short-term and unanticipated shock. Secondly, the population concerned in this paper is senior farmers whose socioeconomic status is relatively low. For those people, financial embarrassment may cause depression. The anticipated effect after policy announcement might start to reduce somewhat stress and the income injection can immediately relieve somewhat stress after policy is implemented.

The income injection shows the impact on mental health but not on self-assessed health and life satisfaction. The following reasons may explain this. First, income might have lagged effects on both indicators. Income may have a lagged effect on self-assessed health due to the health investment after income increases. With respect to life satisfaction, for the population of low social strata, improving financial embarrassment will relieve living stress first and raise life satisfaction afterwards. However, this paper cannot reveal any information about long-term effects of two years or longer. Only the first year after policy implement can be detected due to the limitation of the available data. Second, looking at the questionnaire of CES-D and life

satisfaction in terms of time span (see Table A-1 and Table A-2) the questions of CES-D focus on current mental status whereas the questions of life satisfaction focus not only on current status but also on the comparison of current status with the past, the evaluation of the whole life, and the expectation of future. Life satisfaction is an evaluation of a longer time span, thus, the policy effect on life satisfaction might be ambiguous or be observed more slowly than that on depression.

Finally, with respect to the National Health Insurance, it was also implemented in 1995. Due to this reason, the policy effect identified above might be treated with scepticism. However, this scepticism can be excluded because of two reasons. First, the NHI was unlikely to have a significantly influence the individuals who had been previously covered by the occupational social schemes (both farmers and manufacturing workers). Second, the NHI covers the majority of population which includes farmers and manufacturing workers and therefore it may be expected that any impact would be experienced equally by both groups and therefore would not show up in our estimated effect.

The results in this paper provide evidence that absolute income can somewhat relieve the depression experienced by senior farmers in Taiwanese society. Further research is needed to examine the long term effect of the SFWBIR, however, the benefit of the Senior Farmer Welfare Benefit Interim Regulation has increased over time which makes any such analysis more complicated. These answers can provide a direction for policy makers to make relevant pension policies for the future.

Appendix

Table A-1 Questionnaire of CES-D

Do you have following feelings in the past one week?	No	Yes		
		Rare (1 day)	Sometimes (2-3 days)	Often (more than 3 days)
Have little desire to eat	0	1	2	3
Feel laborious when doing everything	0	1	2	3
Do not sleep well	0	1	2	3
Feel depressed	0	1	2	3
Feel lonely	0	1	2	3
Feel being treated unfriendly	0	1	2	3
Feel sad	0	1	2	3
Cannot be spirited up to do anything	0	1	2	3
Feel happy	3	2	1	0
Enjoy life	3	2	1	0

Note: the number in the table is the score of that response

Table A-2 Questionnaire of Life Satisfaction

	Yes	No
Get a smoother life than other people	1	0
Satisfied with life	1	0
My life could be happier	1	0
I would not like to change my life if I could	1	0
These years are the best years in my life	1	0
Most things I do are boring	0	1
Interested in things which I have done	1	0
Expect pleasant things in the future	1	0
I feel old and somewhat tired	0	1
Most things are the same as my expectation in my life	1	0

Note: the number in the table is the score of that response

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